PATENT ABSTRACTS OF JAPAN

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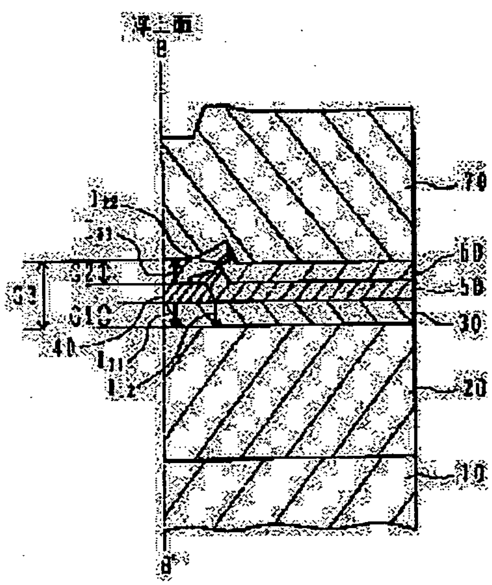
(54) THIN FILM MAGNETIC HEAD

(57)Abstract:
PROBLEM TO BE SOLVED: To improve a withstand voltage between a magneto-resistance effect film and upper and lower shielding films and to improve reliability by making a length between a magneto-resistance effect film of a floating surface part and an upper shielding film smaller than a length between a magneto-resistance effect film on the side off the floating surface part and the upper shielding film.
SOLUTION: This is an end part of a GMR film 40 sequentially forming a lower shielding film 20, a lower gap film 30, and GMR(Giant Magneto-Resistance Effect) film 40 on a substrate 10, and an insulating film 50 is formed so as to cover an end part of the side off a floating surface. An upper gap film 60 and an upper shielding film 70 are sequentially formed on the GMR film 40 and the insulating film 60. Namely, a length I21 between the GMR film 40 on the side of the floating surface and the upper shielding film 70 becomes smaller than that I22 between the GMR film 40 at the position off the floating surface side and the upper shielding film 70. Thus, the length I21 is determinative of a withstand voltage between the GMR film 40 and the upper shielding film 70, and it is possible to secure a necessary length G2.



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CLAIMS

[Claim(s)]
[Claim 1] The lower shielding film and the magneto-resistive effect film formed through the lower gap film on this lower shielding film, In the thin film magnetic head which had the up shielding film prepared through the up gap film on this magneto-resistive effect film, and the above-mentioned magneto-resistive effect film has exposed to a surfacing side The thin film magnetic head characterized by making distance of the above-mentioned magneto-resistive effect film and the above-mentioned up shielding film in a part for the above-mentioned surfacing surface part smaller than the distance of the near above-mentioned magneto-resistive effect film and the near above-mentioned up shielding film which are separated from a part for the above-mentioned surfacing surface part.
[Claim 2] The lower shielding film and the magneto-resistive effect film formed through the lower gap film on this lower shielding film, In the thin film magnetic head which had the up shielding film prepared through the up gap film on this magneto-resistive effect film, and the above-mentioned magneto-resistive effect film has exposed to a surfacing side While having the bias film connected to the both ends of the above-mentioned magneto-resistive effect film, and the electrode layer connected to this bias film and forming the above-mentioned bias film smaller than the above-mentioned electrode layer The thin film magnetic head which forms an insulator layer between the above-mentioned electrode layer and the above-mentioned lower gap film, and is characterized by covering the edge of the near above-mentioned magneto-resistive effect film which is separated from a part for the above-mentioned surfacing surface part, and the above-mentioned bias film by this insulator layer.
[Claim 3] The lower shielding film and the magneto-resistive effect film formed through the lower gap film on this lower shielding film, In the thin film magnetic head which had the up shielding film prepared through the up gap film on this magneto-resistive effect film, and the above-mentioned magneto-resistive effect film has exposed to a surfacing side The thin film magnetic head characterized by forming the damage prevention film so that the edge of the near above-mentioned giant magneto-resistance film which is separated from a part for the above-mentioned surfacing surface part may be covered using the giant magneto-resistance film as the above-mentioned magneto-resistive effect film.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the thin film magnetic head used for magnetic recording media, such as a magnetic disk drive, and relates to the suitable thin film magnetic head to use it for detecting a signal from a magnetic-recording medium especially using a magneto-resistive effect peculiar to a ferromagnetic.
[0002]
[Description of the Prior Art] In the conventional magneto-resistive effect mold thin film magnetic head, it has structure which MR (magneto-resistive effect: Magnetoresistance) film which is a sensor has exposed to the surfacing side over a magnetic-recording medium in the shielding mold thin film magnetic head. The up gap film and the lower gap film are inserted into the upper and lower sides of MR film, respectively, and the up shielding film and the lower shielding film are arranged.
[0003] In addition, the GMR (giant magneto-resistance: Giant Magnetoresistance) film which can acquire a bigger magneto-resistive effect than the conventional MR film in recent years is also developed.
[0004]
[Problem(s) to be Solved by the Invention] Here, the resolution of a regenerative signal is influenced, spacing, i.e., the magnetic gap length, of the vertical shielding film. In order to raise resolution, it is necessary to make the vertical gap film thin and to make spacing of the vertical shielding film small. However, when spacing of the vertical shielding film was made small, there was a problem that the withstand voltage between MR film and the vertical shielding film fell, and the dependability of the thin film magnetic head fell.
[0005] Moreover, as a sensor, when the GMR film was used, in the production process of the thin film magnetic head, there was also a trouble that the edge of the GMR film was etched by resist exfoliation liquid and the penetrant remover.
[0006] The 1st purpose of this invention is to offer the thin film magnetic head whose dependability raised the withstand voltage between the magneto-resistive effect film and the vertical shielding film, and improved.
[0007] The 2nd purpose of this invention is to offer the thin film magnetic head using the GMR film into which the GMR membrane end section is etched by neither resist exfoliation liquid nor the penetrant remover.
[0008]
[Means for Solving the Problem] In order to attain the 1st purpose of the above, (1) This invention The lower shielding film and the magneto-resistive effect film formed through the lower gap film on this lower shielding film, In the thin film magnetic head which had the up shielding film prepared through the up gap film on this magneto-resistive effect film, and the above-mentioned magneto-resistive effect film has exposed to a surfacing side It is made to make distance of the above-mentioned magneto-resistive effect film and the above-mentioned up shielding film in a part for the above-mentioned surfacing surface part smaller than the distance of the near above-mentioned magneto-resistive effect film and the near above-mentioned up shielding film which are separated from a part for the above-mentioned surfacing surface part. By this configuration, in order to raise resolution, also when distance of the magneto-resistive effect film and the vertical shielding film is made small, the withstand voltage between the magneto-resistive effect film and the vertical shielding film is raised, and dependability may be improved.
[0009] In order to attain the 1st purpose of the above, (2) This invention The lower shielding film and the magneto-resistive effect film formed through the lower gap film on this lower shielding film, In the thin film magnetic head which had the up shielding film prepared through the up gap film on this magneto-resistive effect film, and the above-mentioned magneto-resistive effect film has exposed to a surfacing side While having the bias film connected to the both ends of the above-mentioned magneto-resistive effect film, and the electrode layer connected to this bias film and forming the above-mentioned bias film smaller than the above-mentioned electrode layer An insulator layer is formed between the above-mentioned electrode layer and the above-mentioned lower gap film, and the edge of the near above-mentioned magneto-resistive effect film which is separated from a part for the above-mentioned surfacing surface part, and the above-mentioned bias film is covered by this insulator layer. By this configuration, in order to raise resolution in the magnetic head equipped with the bias film, also when distance of the magneto-resistive effect film and the vertical shielding film is made small, the withstand voltage between the magneto-resistive effect film and the vertical shielding film is raised, and dependability may be improved.
[0010] In order to attain the 2nd purpose of the above, (3) This invention The lower shielding film and the magneto-resistive effect film formed through the lower gap film on this lower shielding film, In the thin film magnetic head which had the up shielding film prepared through the up gap film on this magneto-resistive effect film, and the above-mentioned magneto-resistive effect film has exposed to a surfacing side The damage prevention film is formed so that the edge of the near above-mentioned giant magneto-resistance film which is separated from a part for the above-mentioned surfacing surface part may be covered using the giant magneto-resistance film as the above-mentioned magneto-resistive effect film. By this configuration, it is lost that the giant magneto-resistance membrane end section is etched by resist exfoliation liquid and the penetrant remover, and the damage of the giant magneto-resistance film can be prevented.
[0011]
[Embodiment of the Invention] Hereafter, the configuration of the thin film magnetic head by 1 operation gestalt of this invention is explained using drawing 1 - drawing 6 . First, drawing 1 is used and the flat-surface configuration of the thin film magnetic head by this operation gestalt is explained. In addition, in drawing 1 , in order to make a flat-surface configuration easy to understand, the condition before the up gap film, the up shielding film, and the insulator layer by this operation gestalt are formed is shown.
[0012] The lower shielding film 20 is formed on the substrate. The alloy (Al Chick) of aluminum (aluminum) with a thickness of

2mm, titanium (Ti), and carbon (C) is used for the substrate. After forming the alumina (aluminum 2O3) film with a thickness of 10 micrometers by sputtering on a substrate, the lower shielding film 20 with a thickness of 2micro is formed of sputtering or plating. The lower shielding film 20 consists of alloys of cobalt (Co), niobium (Nb), and a zirconium (Zr). As lower shielding film 20, the alloy of iron (Fe), aluminum (aluminum), and silicon (Si) can also be used for others.

[0013] The lower gap film 30 is formed on the lower shielding film 20. The lower gap film 30 is formed of sputtering, and the thickness is 50nm. The lower gap film 30 is an insulator layer which consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2).

[0014] The GMR film 40 is formed on the lower gap film 30. The GMR film 40 is formed of sputtering or CVD, and the thickness is 50nm. The laminating of the tantalum (Ta), permalloy (NiFe alloy), and cobalt (Co) copper (Cu) cobalt (Co) chromium (Cr) (manganese Mn) platinum (Pt) is carried out one by one, and the GMR film 40 is formed. In this, cobalt (Co) and copper (Cu) are the ingredients which tend to be corroded by etching.

[0015] On the both ends of the GMR film 40, the electrode layer 80 to the GMR film 40 is formed. An electrode layer 80 is formed of sputtering or CVD, and the thickness is 50nm or more. An electrode layer 80 carries out the laminating of chromium (Cr), cobalt (Co) and chromium (Cr), the alloy of platinum (Pt) and chromium (Cr), and the tantalum (Ta) one by one, and is formed. Here, the alloy of a tantalum (Ta) and a tungsten (W) can also be used instead of the chromium (Cr) of the 3rd layer (the maximum upper layer side). Moreover, gold (Au) can also be used instead of the tantalum (Ta) of the maximum upper layer.

[0016] Furthermore, an electrode layer 90 is formed on an electrode layer 80. An electrode layer 90 is formed of sputtering and the thickness is 200nm. As for an electrode layer 90, gold (Au) is used.

[0017] Furthermore, in drawing 1 , although not illustrated, on an electrode layer 90, sequential formation of the up gap film and the up shielding film is carried out. After the up shielding film is formed, it is cut in B-B' and the end face is ground. By this cutting polish, it exposes to the surfacing side over a magnetic-recording medium, and the shielding mold thin film magnetic head completes the GMR film 40.

[0018] In addition, it is after formation of an electrode layer 80, and the insulator layer by this operation gestalt is formed before formation of the electrode layer 90 on it so that it may mention later using drawing 2 . The location in which an insulator layer is formed is the edge of the surfacing side of the GMR film 40, and the opposite side, as an arrow head X shows to drawing 1 . After an insulator layer is formed, sequential formation of the upper electrode layer 90, the up gap film, and the up shielding film is carried out.

[0019] Next, the cross-section structure of the thin film magnetic head by this operation gestalt is explained using drawing 2 . Drawing 2 shows the A-A' cross section in the condition of having carried out cutting polish in B-B' of drawing 1 .

[0020] The lower shielding film 20 is formed on a substrate 10, and sequential formation of the lower gap film 30 and the GMR film 40 is carried out further.

[0021] It is the edge of the GMR film 40, and an insulator layer 50 is formed so that the edge of the side which is distant from the surfacing side of the thin film magnetic head may be covered. An insulator layer 50 is formed of sputtering and the thickness is 50nm. An insulator layer 50 consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). It is not etched also in case it etches by lye as an insulator layer 50 by using an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). Moreover, since the edge of the GMR film 40 is also covered with the insulator layer, it is not etched.

[0022] The up gap film 60 is formed on the GMR film 40 and an insulator layer 50. The up gap film 60 is formed of sputtering, and the thickness is 50nm. The up gap film 60 is an insulator layer which consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2).

[0023] On the up gap film 60, the up shielding film 70 with a thickness of 2-3 micrometers is formed of sputtering or plating. The up shielding film 70 consists of permalloys (NiFe alloy).

[0024] Here, the inferior surface of tongue of the GMR film 40 and the distance G1 between the lower shielding film 20 are prescribed by the thickness of the lower gap film 30. Moreover, since the thickness of the lower gap film 30 formed on the lower shielding film 20 is uniform, the inferior surface of tongue of the GMR film 40 and the distance for insulation I11 and I12 between the lower shielding film 20 are equal, and have become 50nm in any location.

[0025] On the other hand, the top face of the GMR film 40 and the distance G2 between the up shielding film 70 are prescribed by the thickness of the up gap film 60. Distance G3 between the up shielding film 70 and the lower shielding film 20 is magnetic gap length, and this is prescribed by the thickness G1 of the lower gap film 30, the thickness of the up gap film 60, and the thickness of the GMR film 40.

[0026] Moreover, since the thickness of the lower gap film 30 formed on the lower shielding film 20 is uniform, the inferior surface of tongue of the GMR film 40 and the distance for insulation I11 and I12 between the lower shielding film 20 are equal, and have become 50nm in any location. Therefore, the inferior surface of tongue of the GMR film 40 and the withstand voltage between the lower shielding film 20 become settled according to the distance for insulation I11 and I12.

[0027] Furthermore, the top face of the GMR film 40 and the distance for insulation between the up shielding film 70 are I21 in the part (part of the side near a surfacing side) in which the direct up gap film 60 is formed on the GMR film 40, and this is 50nm equal to the thickness of the up gap film 60. On the other hand, in the part of the side which is distant from the surfacing side of the GMR film 40, it is I22 and this becomes what added the thickness of the up gap film 60 to the thickness of an insulator layer 50. The thickness of the insulator layer 50 in the part which is distant from the surfacing side of the GMR film 40 is thinner than 50nm. This is because the thickness of that part becomes thinner than 50nm, in order that the GMR film 40 may be formed by the thickness which is 50nm and may form an insulator layer 50 on the edge of this GMR film 40 to the flat surface of the lower gap film 30. Moreover, the thickness of the up gap film 60 in this part also becomes thinner than 50nm. However, since the distance for insulation I22 in the edge of the side which is distant from the surfacing side of the GMR film 40 becomes what added the thickness of the up gap film 60 to the thickness of an insulator layer 50, the thickness of 50nm or more is securable. That is, in this operation gestalt, distance I21 of the GMR film 40 by the side of a surfacing side and the up shielding film 70 is made smaller than the distance I22 of the GMR film 40 in the location distant from the surfacing side side, and the up shielding film 70 by using an insulator layer 50.

[0028] Even when an insulator layer 50 was not used conventionally and the thickness of the up gap film 60 was formed by 50nm, the thickness of the up gap film 60 in the edge of the side which is distant from the surfacing side of the GMR film 40 was 40nm or less. Therefore, the withstand voltage between the GMR film 40 and the up shielding film 70 was restricted by the thickness of the up gap film 60 in the edge of the side which is distant from the surfacing side of the GMR film 40. The withstand voltage at this time was less than [40V].

[0029] Since the withstand voltage between the GMR film 40 and the up shielding film 70 is decided by this operation gestalt with

the distance I21 of the up shielding film 70 the surfacing side side of the GMR film 40 to it, 50nm is securable. Withstand voltage at this time can be set to 50V. Therefore, with this operation gestalt, withstand voltage can be raised and dependability can be improved.

[0030] Moreover, since the field which went into the GMR film 40 from the magnetic-recording medium by the ability enlarging distance I22 of the GMR film 40 in the location distant from the surfacing side side and the up shielding film 70 stops being able to go into the up shielding film 70 easily, resistance change in the GMR film 40 becomes large, and an output improves.

[0031] Next, the cross-section structure at the time of seeing the thin film magnetic head by this operation gestalt from other directions is explained using drawing 3 . Drawing 3 shows the B-B' cross section of drawing 1 .

[0032] The lower shielding film 20 is formed on a substrate 10, and sequential formation of the lower gap film 30 and the GMR film 40 is carried out further.

[0033] An electrode layer 80 is formed in the both ends of the GMR film 40 so that it may flow with the GMR film 40. The mask which can form the GMR film 40 and an electrode layer 80 in a predetermined configuration at coincidence is used, and the resist pattern of the lift-off method is formed. The GMR film 40 and an electrode layer 80 can be formed in coincidence at a predetermined configuration using this resist pattern.

[0034] Then, as explained in drawing 2 , an insulator layer 50 is formed so that the edge of the GMR film 40 may be covered, and as shown in drawing 1 , an electrode layer 90 is formed on an electrode layer 80.

[0035] Furthermore, sequential formation of the up gap film 60 and the up shielding film 70 is carried out on the GMR film 40, an insulator layer 50, and the whole electrode layers 80 and 90.

[0036] Here, the relation between an insulator layer and a two-layer electrode layer is explained using drawing 4 and drawing 5 . Drawing 4 and drawing 5 show the C-C' cross section of drawing 1 .

[0037] As shown in drawing 4 , the lower shielding film 20 is formed on a substrate 10, and sequential formation of the lower gap film 30 is carried out further.

[0038] The GMR film and an electrode layer 80 are formed on the lower gap film 30.

[0039] Then, an insulator layer 50 is formed so that the edge of an electrode layer 80 and the edge of the GMR film may be covered, and an electrode layer 90 is formed on an electrode layer 80.

[0040] Furthermore, as shown in drawing 5 , sequential formation of the up gap film 60 and the up shielding film 70 is carried out on the GMR film, an insulator layer 50, and the whole electrode layers 80 and 90.

[0041] In drawing 5 , in the part shown by the arrow head (a), (b), (c), and (d), an insulator layer 50 is formed in the edge of an electrode layer 80, and the up gap film 60 and the up shielding film 70 are further formed on it. Therefore, since distance from the upper part of an electrode layer 80 to the inferior surface of tongue of the up shielding film 70 is greatly made compared with the case where there is no insulator layer 50, the withstand voltage between an electrode and the up shielding film can be improved.

[0042] Next, the manufacture process of the whole thin film magnetic head by this operation gestalt is explained using drawing 6 . In addition, - (B-1) (B-3) of drawing 6 shows the A-A' cross section of drawing 1 , and - (A-1) (A-3) of drawing 6 shows the B-B' cross section of drawing 1 . Moreover, unlike drawing 2 , - (A-1) (A-3) of drawing 6 shows the A-A' cross section in the condition, i.e., drawing 1 , before being cut in the field of B-B' itself.

[0043] As shown in drawing 6 (B-1) and (A-1), on the substrate 10 which consists of an alloy (Al Chick) of aluminum (aluminum) with a thickness of 2mm, titanium (Ti), and carbon (C) After forming the alumina (aluminum 2O3) film with a thickness of 10 micrometers by sputtering, the lower shielding film 20 which consists of cobalt (Co) with a thickness of 2micro, niobium (Nb), and a zirconium (Zr) is formed of sputtering or plating.

[0044] On the lower shielding film 20, the lower gap film 30 with which thickness consists of an alumina (aluminum 2O3) which is 50nm, and diacid-ized silicon (SiO_2) is formed of sputtering.

[0045] On the lower gap film 30, the laminating of the tantalum (Ta), permalloy (NiFe alloy), and cobalt (Co) copper (Cu) cobalt (Co) chromium (Cr) (manganese Mn) platinum (Pt) is carried out one by one, and the GMR film 40 whose thickness is 50nm is formed of sputtering or CVD.

[0046] Furthermore, as shown in (B-1), on the both ends of the GMR film 40, the laminating of chromium (Cr), cobalt (Co) and chromium (Cr), the alloy of platinum (Pt) and chromium (Cr), and the tantalum (Ta) is carried out one by one, and the electrode layer 80 whose thickness is 50nm is formed of sputtering or CVD. An electrode layer 80 is formed in the resist bottom using the resist pattern of the lift-off method into which the undercut was put. Next, the garbage of the GMR film 40 is removed by ion milling.

[0047] Next, as shown in (A-2), it is the edge of the GMR film 40, and the insulator layer 50 which thickness becomes from the alumina (aluminum 2O3) which is 50nm, and diacid-ized silicon (SiO_2) is formed of sputtering so that the edge of the side which intersects perpendicularly to the side in which an electrode layer 80 is formed may be covered.

[0048] The resist of the lift-off method used for formation of the GMR film 40 and an electrode layer 80 is removed after formation of an insulator layer 50 using resist exfoliation liquid, and a substrate is further washed by the penetrant remover after resist exfoliation. Here, since it is covered with the insulator layer 50, even if removal of a resist is performed by alkaline resist exfoliation liquid, it is lost that cobalt (Co) and copper (Cu) in the GMR film 40 are corroded of the edge of the GMR film 40, and it can prevent the damage of the GMR film 40.

[0049] Next, as shown in drawing 1 , the electrode layer 90 which thickness becomes from the gold (Au) which is 200nm is formed of sputtering on an electrode layer 80.

[0050] Furthermore, as shown in (B-3) and (A-3), the up gap film 60 with which thickness consists of an alumina (aluminum 2O3) which is 50nm, and diacid-ized silicon (SiO_2) is formed of sputtering so that the GMR film 40, an insulator layer 50, and electrode layers 80 and 90 may be covered.

[0051] On the up gap film 60, the up shielding film 70 which consists of a permalloy (NiFe alloy) with a thickness of 2-3 micrometers is formed of sputtering or plating.

[0052] In B-B' in drawing 1 , it is cut after formation of the up shielding film 70, and the GMR film 40 which is a sensor can constitute the shielding mold thin film magnetic head of the structure exposed to the surfacing side by grinding the cutting plane.

[0053] In this operation gestalt, in the part of the side which is distant from the surfacing side of the GMR film 40, the top face of the GMR film 40 and the distance for insulation between the up shielding film 70 become what added the thickness of the up gap film 60 to the thickness of an insulator layer 50, and can secure the thickness of 50nm or more. That is, in this operation gestalt, distance of the GMR film 40 by the side of a surfacing side and the up shielding film 70 is made smaller than the distance of the GMR film 40 in the location distant from the surfacing side side, and the up shielding film 70 by using an insulator layer 50. By this, with this operation gestalt, withstand voltage can be raised and dependability can be improved.

[0054] Moreover, it is the edge of the GMR film 40, and since he is trying to cover the edge of the side which is separated from a surfacing side side by the insulator layer 50, it is lost that cobalt (Co) and copper (Cu) in the GMR film 40 are corroded also in the case of removal of a resist.
[0055] In addition, it replaces with the GMR film, and although explained as magneto-resistive effect film as what uses the GMR film 40, even if it uses MR film, it can constitute from the above explanation similarly. When using MR film, in drawing 6 (B-1) and the process shown in (A-1), on the lower gap film 30, the laminating of the alloy containing NiFe, a tantalum (Ta), a permalloy (NiFe alloy), and the tantalum (Ta) is carried out one by one, and MR film whose thickness is 50nm is formed of sputtering or CVD.
[0056] Since an insulator layer is formed in the edge distant from the surfacing side side of MR film as shown in (A-2) also when using MR film, in the part of the side which is distant from the surfacing side of MR film, the top face of MR film and the distance for insulation between the up shielding film 70 become what added the thickness of the up gap film 60 to the thickness of an insulator layer 50, and can secure the thickness of 50nm or more. That is, distance of MR film by the side of a surfacing side and the up shielding film 70 is made smaller than the distance of MR film in the location distant from the surfacing side side, and the up shielding film 70 by using an insulator layer 50. By this, with this operation gestalt, withstand voltage can be raised and dependability can be improved.
[0057] In addition, in MR film, since cobalt (Co) and copper (Cu) which are etched with alkaline resist exfoliation liquid are not contained, etching-proof nature does not increase.
[0058] Next, the thin film magnetic head which the 2nd operation gestalt of this invention depends is explained using drawing 7. In addition, drawing 7 is drawing corresponding to drawing 2 in the 1st operation gestalt, and the same sign as drawing 2 shows the same part. moreover — a book — operation — a gestalt — depending — a thin film — the magnetic head — a flat surface — a configuration — drawing 1 — having been shown — a thing — the same — drawing 7 — drawing 1 — B-B — ' — setting — cutting — polish — having carried out — a condition — it can set — A-A — ' — a cross section — being shown — ****.
[0059] The lower shielding film 20 is formed on a substrate 10, and sequential formation of the lower gap film 30 and the GMR film 40 is carried out further. The quality of the material of a substrate 10, the lower shielding film 20, the lower gap film 30, and the GMR film 40, thickness, and the membrane formation approach are the same as that of the 1st operation gestalt.
[0060] As shown in drawing 3, in the both ends of the GMR film 40, an electrode layer 80 is formed so that it may flow with the GMR film 40, and although not shown in drawing 7, as shown in drawing 1, an electrode layer 90 is formed on an electrode layer 80. The quality of the material, the thickness, and the membrane formation approach of electrode layers 80 and 90 are the same as that of the 1st operation gestalt.
[0061] Up gap film 60A is formed on the GMR film 40, the lower gap film 30, and electrode layers 80 and 90. Up gap film 60A is formed of sputtering, and the thickness is 50nm. Up gap film 60A is an insulator layer which consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2).
[0062] In the part on the GMR film 40, since up gap film 60A forms heights, as it covers the edge of these heights, it forms insulator layer 50A. Insulator layer 50A is formed of sputtering, and the thickness is 50nm. Insulator layer 50A consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2).
[0063] On up gap film 60A and insulator layer 50A, the up shielding film 70 with a thickness of 2-3 micrometers is formed of sputtering or plating.
[0064] Even if it forms an insulator layer on the up gap film as mentioned above, the top face of the GMR film 40, and the distance for insulation between the up shielding film 70 In the part (part of the side near a surfacing side) in which the direct up gap film 60 is formed on the GMR film 40 It is set to 50nm equal to the thickness of the up gap film 60, and becomes what added the thickness of insulator layer 50A to the thickness of up gap film 60A in the part of the side which is distant from the surfacing side of the GMR film 40. Therefore, since the distance for insulation in the edge of the side which is distant from the surfacing side of the GMR film 40 becomes what added the thickness of insulator layer 50A to the thickness of up gap film 60A, the thickness of 50nm or more is securable. That is, in this operation gestalt, distance of the GMR film 40 by the side of a surfacing side and the up shielding film 70 is made smaller than the distance of the GMR film 40 in the location distant from the surfacing side side, and the up shielding film 70 by using insulator layer 50A. By this, with this operation gestalt, withstand voltage can be raised and dependability can be improved.
[0065] Next, the thin film magnetic head which the 3rd operation gestalt of this invention depends is explained using drawing 8 - drawing 12. In addition, drawing 8 is drawing corresponding to drawing 3 in the 1st operation gestalt, and the same sign as drawing 3 shows the same part. moreover — a book — operation — a gestalt — depending — a thin film — the magnetic head — a flat surface — a configuration — drawing 1 — having been shown — a thing — the same — drawing 8 — drawing 1 — B-B — ' — setting — cutting — polish — having carried out — a condition — it can set — A-A — ' — a cross section — being shown — ****.
[0066] In addition to the configuration shown in drawing 3, in this operation gestalt, it has the bias film 85. The bias film 85 is conductivity, and it connects with the both ends of the GMR film 40, and it gives a bias field to the GMR film 40. The bias film 85 is connected to an electrode layer 80.
[0067] Magnitude of the bias film 85 is made small compared with the conventional bias film. That is, the conventional bias film serves as the almost same magnitude as the electrode layer 80 shown in drawing 1. To it, the bias film 85 in this operation gestalt makes width of face in the direction (the direction of A-A' of drawing 1) which intersects perpendicularly with a surfacing side the almost same thing as the GMR film 40 so that it may mention later using drawing 10 and drawing 11.
[0068] In the case of the magnitude as an electrode layer 80 with the almost same magnitude of the bias film 85, insulate by the lower gap film 30 between the bias film 85 and the lower shielding film 20, but If gap length GL is made small and the vertical gap film, especially the lower gap film 30 are made thin in order to raise the resolution of the magnetic head Withstand voltage will fall under the effect of the pinhole formed in the foreign matter which adhered on the lower shielding film 20 and remained between the lower gap film 30 and the lower shielding film 20, or the lower gap film 30.
[0069] Then, he is trying to reduce the probability of a fall of the withstand voltage by the foreign matter or the pinhole by making magnitude of the bias film 85 small. Moreover, since an electrode layer 80 will contact the lower gap film 30, he is trying to form an insulator layer 50 between an electrode layer 80 and the lower gap film 30, only by making magnitude of the bias film 85 small, so that it may mention later using drawing 11. This insulator layer 50 is formed so that the edge of the near bias film 85 which is separated from a part for a surfacing surface part may be covered.
[0070] As shown in drawing 8, the lower shielding film 20 is formed on the substrate 10. The alloy (Al Chick) of aluminum (aluminum) with a thickness of 2mm, titanium (Ti), and carbon (C) is used for the substrate 10. After forming the alumina

(aluminum 2O3) film with a thickness of 10 micrometers by sputtering on a substrate 10, the lower shielding film 20 with a thickness of 2 micrometers is formed of sputtering or plating. The lower shielding film 20 consists of cobalt (Co), and niobium (Nb) and the alloy of a zirconium (Zr). As lower shielding film 20, the alloy (Sendust) of iron (Fe), aluminum (aluminum), and silicon (Si) and a permalloy (nickel-Fe) can also be used for others.

[0071] The lower gap film 30 is formed on the lower shielding film 20. The lower gap film 30 is formed of sputtering or CVD, and the thickness is 70-80nm. The lower gap film 30 is an insulator layer which consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). An insulating material with sufficient thermal conductivity like AlN and diamond-like carbon (DLC) as lower gap film 30 can also be used.

[0072] The GMR film 40 is formed on the lower gap film 30. The GMR film 40 is formed of sputtering or CVD, and the thickness is 50nm. The laminating of the tantalum (Ta), permalloy (NiFe alloy), and cobalt (Co) copper (Cu) cobalt (Co) chromium (Cr) (manganese Mn) platinum (Pt) is carried out one by one, and the GMR film 40 is formed. In this, cobalt (Co) and copper (Cu) are the ingredients which tend to be corroded by etching.

[0073] On the both ends of the GMR film 40, the bias film 85 to the GMR film 40 is formed. The bias film 85 is formed of sputtering and the thickness is 50nm. A hard magnetic material like Co-Cr-Pt is used for the bias film 85. An antiferromagnetism ingredient like Fe-Mn can also be used as bias film 85. The bias film 85 gives a bias field to the GMR film 40.

[0074] An electrode layer 80 is formed on the bias film 85. An electrode layer 80 is formed of sputtering or CVD, and the thickness is 70nm. A tantalum (Ta), a tungsten (W), molybdenum (Mo), gold (Au), aluminum (aluminum), and an ingredient with low resistivity like copper (Cu) are used for an electrode layer 80.

[0075] The up gap film 60 is formed on the GMR film 40 and an electrode layer 80. The up gap film 60 is formed of sputtering or CVD, and the thickness is 70-80nm. The up gap film 60 is an insulator layer which consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). An insulating material with sufficient thermal conductivity like AlN and diamond-like carbon (DLC) as up gap film 80 can also be used.

[0076] On the up gap film 60, the up shielding film 70 with a thickness of 2 micrometers is formed of sputtering or plating. The up shielding film 70 consists of permalloys (NiFe alloy).

[0077] After the up shielding film 70 is formed, it is cut in B-B' (surfacing side) shown in drawing 1 , and the end face is ground. By this cutting polish, it exposes to the surfacing side over a magnetic-recording medium, and the shielding mold thin film magnetic head completes the GMR film 40.

[0078] In addition, it is after formation of an electrode layer 80, and the insulator layer by this operation gestalt is formed before formation of the up gap film 60 so that it may mention later using drawing 9 - drawing 11 . The location in which an insulator layer is formed is the edge of the surfacing side of the GMR film 40 and the bias film 85, and the opposite side. After an insulator layer is formed, sequential formation of the up gap film 60 and the up shielding film 70 is carried out.

[0079] Next, the insulator layer used for the thin film magnetic head which the 3rd operation gestalt of this invention depends is explained using drawing 9 - drawing 11 . In addition, drawing 9 shows the A-A' cross section of drawing 8 , drawing 10 shows the D-D' cross section of drawing 8 , and drawing 11 shows the E-E' cross section of drawing 8 .

[0080] As shown in drawing 9 - drawing 11 , the lower shielding film 20 is formed on a substrate 10, and sequential formation of the lower gap film 30 is carried out further. Furthermore, as shown in drawing 9 , the GMR film 40 is formed on the lower gap film 30, next as shown in drawing 10 and drawing 11 , the bias film 85 is formed in the both sides of the GMR film 40.

[0081] Next, it is the edge of the GMR film 40, and as shown in drawing 10 and drawing 11 , it is the edge of the bias film 85, and as shown in drawing 9 , an insulator layer 50 is formed so that the edge of the side which is distant from the surfacing side of the thin film magnetic head may be covered, so that the edge of the side which is distant from the surfacing side of the thin film magnetic head may be covered. An insulator layer 50 is formed of sputtering and the thickness is 50-100nm. That is, it is considering as the range of twice as many thickness as the GMR film 40 from the same thickness as the GMR film 40. When it is decided in consideration of the covering power in the insulating engine performance and level difference edge of an insulating material and a magneto-resistive effect mold head is designed like the lower gap film 30 or the up gap film 60, the thickness of an insulator layer 50 is not the film which must restrict thickness severely, and should just have the thickness which can maintain the insulating engine performance.

[0082] The insulator layer 50 consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). It is not etched also in case it etches by lye as an insulator layer 50 by using an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). Moreover, since the edge of the GMR film 40 is also covered with the insulator layer 50, it is not etched. In addition, an insulating material with alumimium nitride (AlN), the sufficient silicon nitride (Si3N4), and sufficient thermal conductivity like diamond-like carbon (DLC) as an insulator layer 50 can also be used.

[0083] Next, as shown in drawing 10 and drawing 11 , an electrode layer 80 is formed on the bias film 85. Furthermore, as shown in drawing 9 - drawing 11 , the up gap film 60 is formed on the GMR film 40, an insulator layer 50, and an electrode layer 80.

[0084] Moreover, as shown in drawing 9 - drawing 11 , the up insulator layer 55 with a thickness of 0.5-1 micrometer is formed in the location distant from the surfacing side of the up gap film 60 of sputtering. It has the up insulator layer 55 in order to enlarge distance between an electrode layer 80 and the up shielding film 70 and to improve withstand voltage, as shown in drawing 11.

[0085] As shown in drawing 9 - drawing 11 , the up shielding film 70 with a thickness of 2 micrometers is formed of sputtering or plating on the up gap film 60 and the up insulator layer 55. The up shielding film 70 consists of permalloys (NiFe alloy).

[0086] Here, as shown in drawing 11 , in this operation gestalt, the distance G4 between an electrode layer 80 and the lower shielding film 20 is prescribed by the thickness of the lower gap film 30 and insulator layer 50 which have insulation. In the conventional magnetic head, since an insulator layer 50 was not used but the bias film of the almost same area as an electrode layer 80 was prepared in the bottom of an electrode layer 80, the bias film and the lower shielding film 20 are only insulated with the lower gap film 30. Therefore, in order to raise the resolution of the magnetic head, when gap length GL is made small and the lower gap film 30 is made thin, withstand voltage will fall under the effect of the pinhole formed in the foreign matter which adhered on the lower shielding film 20 and remained between the lower gap film 30 and the lower shielding film 20, or the lower gap film 30.

[0087] Then, he is trying to reduce the probability of a fall of the withstand voltage by the foreign matter or the pinhole by making area of the bias film 85 small in this operation gestalt. Moreover, only by making magnitude of the bias film 85 small, since an electrode layer 80 will contact the lower gap film 30, as shown in drawing 11 , the insulator layer 50 is formed between an electrode layer 80 and the lower gap film 30. Therefore, the distance between an electrode layer 80 and the lower shielding film 20 is set to G4, and can improve withstand voltage.

[0088] Moreover, since the insulator layer 50 is formed so that the edge of the near bias film 85 which is separated from a part

for a surfacing surface part may be covered as shown in drawing 10 , it can enlarge the distance for insulation I32 from the edge of the bias film 85 to the up shielding film 70, and can enlarge withstand voltage between the bias film 85 and the up shielding film 70.

[0089] Furthermore, as it explains in the operation gestalt shown in drawing 2 and was shown in drawing 9 , by using an insulator layer 50, by making the distance for insulation I21 of the GMR film 40 by the side of a surfacing side, and the up shielding film 70 smaller than the distance insulation I22 of the GMR film 40 in the location distant from the surfacing side side, and the up shielding film 70, withstand voltage can be raised and dependability can be improved.

[0090] Next, the manufacture process of the thin film magnetic head by this operation gestalt is explained using drawing 12 . In drawing 12 in addition, the chart on the left (a), (c), (d), (e), (g), (h), and (j) It is a process Fig. when seeing from the location equivalent to a magnetic-medium opposed face, and right-hand side drawing (b), (f), (i), and (k) are drawings which looked at a left-hand side process Fig. (a), (e), (h), and (j) from the top.

[0091] As shown in drawing 12 (a), the lower shielding film 20 is formed on the substrate which is not illustrated. The lower gap film 30 is formed on it, and the GMR film 40 is further formed on it. Furthermore, in the case of hard bias structure, in order to form the bias film, the stencil-like resist pattern RP 1 is formed. A resist pattern RP 1 is a pattern in which the field which forms the bias film is carrying out opening, as shown in drawing 12 (b).

[0092] Next, as shown in drawing 12 (c), the GMR film 40 of the field which forms the bias film is removed by ion milling IM etc. by using a resist pattern RP 1 as a mask. GMR film 40B is a part finally used as a sensor of the magnetic head, and the GMR film 40A and 40C is removed at subsequent processes.

[0093] Next, as shown in drawing 12 (d), the bias film 85 is formed by sputtering by using a resist pattern RP 1 as a mask. Finally the bias film 85A and 85B is used as bias film at subsequent processes. The bias film 85 formed in the top face of a resist pattern RP 1 and this resist pattern RP 1 is removed after formation of the bias film using resist exfoliation liquid.

[0094] Next, as shown in drawing 12 (e) and (f), in order to fabricate GMR film 40B in a predetermined sensor configuration, the stencil-like resist pattern RP 2 is formed. The resist pattern RP 2 makes the wrap configuration GMR film 40B and the bias film 85A and 85B which it should leave, as shown in drawing 12 (f).

[0095] And as shown in drawing 12 (g), it leaves the parts of the GMR film 40 which has a final configuration, and the bias film 85 by using a resist pattern RP 2 as a mask using ion milling IM etc., and an excessive part is removed.

[0096] Then, as shown in drawing 12 (h) and (i), an insulator layer 50 is formed, using this resist pattern RP 2 again. As explained in the periphery of the GMR film 40 and the bias film 85, i.e., drawing 9 , and drawing 10 , an insulator layer 50 is formed so that the edge of the side which is distant from the surfacing side of the GMR film 40 and the bias film 85 may be covered. Therefore, since an insulator layer 50 is formed immediately after fabricating the GMR film 40 by ion milling, the edge of the GMR film 40 which ingredients, such as Cu, Co, etc. which are easy to be corroded with the solution in the process which forms a magneto-resistive effect mold head, expose can produce a magneto-resistive effect mold head, without not touching the solution in a process, therefore the GMR film 40 corroding.

[0097] After formation of an insulator layer 50, by removing excessive insulator layer 50A formed on the resist pattern RP 2 and the resist pattern RP 2 using resist exfoliation liquid, as shown in drawing 12 (i), the bias film 85 is formed in the both sides of the GMR film 40, and the front face of those perimeters can consider as the configuration covered with the insulator layer 50.

[0098] Next, as shown in drawing 12 (j) and (k), the electrode layer 80 for connecting the GMR film 40 with a terminal is formed on the bias film 85. Although the electrode layer 80 has flowed with the bias film 85 in the end, the most is formed on an insulator layer 50. Therefore, an insulator layer 50 and the lower gap film 30 are formed in the bottom of it, and most electrode layers 80 can improve the withstand voltage between the lower shielding film 20.

[0099] Then, as explained in drawing 9 - drawing 11 , sequential formation of the up gap film 60, the up insulator layer 55, and the up shielding film 70 is carried out. And it is cut along with B-B' shown in drawing 12 (k), the cutting plane is ground, and the magnetic head is formed. The cross-section structure of A-A' of drawing 12 (k) is as having been shown in drawing 9 , the cross-section structure of D-D' of drawing 12 (k) is as having been shown in drawing 10 , and the cross-section structure of E-E' of drawing 12 (k) is as having been shown in drawing 11 .

[0100] Since he is trying to have an insulator layer 50 between an electrode layer 80 and the lower gap film 30 according to this operation gestalt as explained above while making the bias film 85 smaller than an electrode layer 80, the withstand voltage between an electrode layer 80 and the lower shielding film 20 can be improved.

[0101] Moreover, since he is trying to cover the edge of the side which is distant from the surfacing side of the bias film 85 by the insulator layer 50, the withstand voltage between the bias film 85 and the up shielding film 70 can be improved.

[0102] Furthermore, since distance of the GMR film 40 by the side of a surfacing side and the up shielding film 70 is made smaller than the distance of the GMR film 40 in the location distant from the surfacing side side, and the up shielding film 70 by using an insulator layer 50, withstand voltage can be raised and dependability can be improved.

[0103] Moreover, it is the edge of the GMR film 40, and since he is trying to cover the edge of the side which is separated from a surfacing side side by the insulator layer 50, it is lost that cobalt (Co) and copper (Cu) in the GMR film 40 are corroded also in the case of removal of a resist.

[0104] In addition, it replaces with the GMR film, and although explained as magneto-resistive effect film as what uses the GMR film 40, even if it uses MR film, it can constitute from the above explanation similarly. When using MR film, on the lower gap film 30, the laminating of the alloy containing NiFe, a tantalum (Ta), a permalloy (NiFe alloy), and the tantalum (Ta) is carried out one by one, and MR film whose thickness is 50nm is formed of sputtering or CVD.

[0105] Since an insulator layer is formed in the edge distant from the surfacing side side of MR film also when using MR film, withstand voltage can be raised and dependability can be improved.

[0106] Next, the thin film magnetic head which the 4th operation gestalt of this invention depends is explained using drawing 13 - drawing 16 .

[0107] In addition, the same sign as drawing 9 shows the same part, the same sign as drawing 10 shows the same part, drawing 13 is drawing corresponding to drawing 9 in the 3rd operation gestalt, and the same sign as drawing 11 shows [drawing 14 is drawing corresponding to drawing 10 , and / drawing 15 is drawing corresponding to drawing 11 , and] the same part.

[0108] As shown in drawing 13 - drawing 15 , the lower shielding film 20 is formed on the substrate 10 which consists of an alloy (Al Chick) of aluminum (aluminum) with a thickness of 2mm, titanium (Ti), and carbon (C). The lower shielding film 20 is 2 micrometers in thickness, and is formed of sputtering or plating. The lower shielding film 20 consists of cobalt (Co), and niobium (Nb) and the alloy of a zirconium (Zr). As lower shielding film 20, the alloy (Sendust) of iron (Fe), aluminum (aluminum), and silicon (Si) and a permalloy (nickel-Fe) can also be used for others.

[0109] The lower gap film 30 is formed on the lower shielding film 20. The lower gap film 30 is formed of sputtering or CVD, and the thickness is 70-80nm. The lower gap film 30 is an insulator layer which consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). An insulating material with sufficient thermal conductivity like AlN and diamond-like carbon (DLC) as lower gap film 30 can also be used.

[0110] Furthermore, as shown in drawing 13, the GMR film 40 is formed on the lower gap film 30. The GMR film 40 is formed of sputtering or CVD, and the thickness is 50nm. The laminating of the tantalum (Ta), permalloy (NiFe alloy), and cobalt (Co) copper (Cu) cobalt (Co) chromium (Cr) (manganese Mn) platinum (Pt) is carried out one by one, and the GMR film 40 is formed.

[0111] Next, as shown in drawing 14 and drawing 15, the bias film 85 is formed in the both ends of the GMR film 40. The bias film 85 is formed of sputtering and the thickness is 50nm. A hard magnetic material like Co-Cr-Pt is used for the bias film 85. An antiferromagnetism ingredient like Fe-Mn can also be used as bias film 85. The bias film 85 gives a bias field to the GMR film 40.

[0112] Furthermore, as shown in drawing 14 and drawing 15, the 1st electrode layer 80 is formed on the bias film 85. The 1st electrode layer 80 is formed of sputtering or CVD, and the thickness is 70nm. Refractory metals, such as a tantalum (Ta), a tungsten (W), and molybdenum (Mo), are used for the 1st electrode layer 80 from a viewpoint of electron migration. Moreover, the alloy of these metals may be used or the laminating of these metals may be carried out one by one. Moreover, gold (Au) and an ingredient with low resistivity like aluminum (aluminum) can also be used.

[0113] Next, it is the edge of the GMR film 40, and as shown in drawing 14 and drawing 15, it is the edge of the bias film 85 and the 1st electrode layer 80, and as shown in drawing 13, an insulator layer 50 is formed so that the edge of the side which is distant from the surfacing side of the thin film magnetic head may be covered, so that the edge of the side which is distant from the surfacing side of the thin film magnetic head may be covered. An insulator layer 50 is formed of sputtering and the thickness is 50-100nm. That is, it is considering as the range of twice as many thickness as the GMR film 40 from the same thickness as the GMR film 40. When it is decided in consideration of the covering power in the insulating engine performance and level difference edge of an insulating material and a magneto-resistive effect mold head is designed like the lower gap film 30 or the up gap film 60, the thickness of an insulator layer 50 is not the film which must restrict thickness severely, and should just have the thickness which can maintain the insulating engine performance.

[0114] The insulator layer 50 consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). It is not etched also in case it etches by lye as an insulator layer 50 by using an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). Moreover, since the edge of the GMR film 40 is also covered with the insulator layer 50, it is not etched. In addition, an insulating material with alumimium nitride (AlN), the sufficient silicon nitride (Si3N4), and sufficient thermal conductivity like diamond-like carbon (DLC) as an insulator layer 50 can also be used.

[0115] Next, as shown in drawing 14, the 2nd electrode layer 90 is formed on the 1st electrode layer 80. The 2nd electrode layer 90 is formed of sputtering or CVD, and the thickness is 200nm. Gold (Au), aluminum (aluminum), and an ingredient with low resistivity like copper (Cu) are used for the 2nd electrode layer 80, and it makes the resistivity of the whole component low.

[0116] As shown in drawing 13 - drawing 15, the up gap film 60 is formed on the GMR film 40 and the 2nd electrode layer 90. The up gap film 60 is formed of sputtering or CVD, and the thickness is 70-80nm. The up gap film 60 is an insulator layer which consists of an alumina (aluminum 2O3) and diacid-ized silicon (SiO2). An insulating material with sufficient thermal conductivity like AlN and diamond-like carbon (DLC) as up gap film 80 can also be used.

[0117] Moreover, as shown in drawing 13 - drawing 15, the up insulator layer 55 with a thickness of 0.5-1 micrometer is formed in the location distant from the surfacing side of the up gap film 60 of sputtering. By having the up insulator layer 55, distance between the 2nd electrode layer 90 and the up shielding film 70 is enlarged, and withstand voltage is improved.

[0118] Furthermore, as shown in drawing 13 - drawing 15, the up shielding film 70 with a thickness of 2 micrometers is formed of sputtering or plating on the up gap film 60 and the up insulator layer 55. The up shielding film 70 consists of permalloys (NiFe alloy).

[0119] Next, the manufacture process of the thin film magnetic head by this operation gestalt is explained using drawing 16. In drawing 16 in addition, the chart on the left (a), (c), (d), (e), (g), (h), and (j) It is a process Fig. when seeing from the location equivalent to a magnetic-medium opposed face, and right-hand side drawing (b), (f), (i), and (k) are drawings which looked at a left-hand side process Fig. (a), (e), (h), and (j) from the top.

[0120] As shown in drawing 16 (a), the lower shielding film 20 is formed on the substrate which is not illustrated. The lower gap film 30 is formed on it, and the GMR film 40 is further formed on it. Furthermore, in the case of hard bias structure, in order to form the bias film, the stencil-like resist pattern RP 1 is formed. A resist pattern RP 1 is a pattern in which the field which forms the bias film is carrying out opening, as shown in drawing 16 (b).

[0121] Next, as shown in drawing 16 (c), the GMR film 40 of the field which forms the bias film is removed by ion milling IM etc. by using a resist pattern RP 1 as a mask. GMR film 40B is a part finally used as a sensor of the magnetic head, and the GMR film 40A and 40C is removed at subsequent processes.

[0122] Next, as shown in drawing 16 (d), the bias film 85 is formed by sputtering by using a resist pattern RP 1 as a mask, next the 1st electrode layer 80 is formed. Finally the bias film 85A and 85B is used as bias film at subsequent processes, and, finally electrode layers 80A and 80B are used as the 1st electrode layer at subsequent processes. The bias film 85 and the 1st electrode layer 80 which were formed in the top face of a resist pattern RP 1 and this resist pattern RP 1 are removed after formation of the 1st electrode layer using resist exfoliation liquid.

[0123] Next, as shown in drawing 16 (e) and (f), in order to fabricate GMR film 40B in a predetermined sensor configuration, the stencil-like resist pattern RP 3 is formed. The resist pattern RP 3 makes the wrap configuration GMR film 40B and the 1st electrode layer 80A and 80B which it should leave, as shown in drawing 16 (f).

[0124] And as shown in drawing 16 (g), it leaves the part of the GMR film 40, the bias film 85, and the 1st electrode layer 80 which have a final configuration by using a resist pattern RP 3 as a mask using ion milling IM etc., and an excessive part is removed.

[0125] Then, as shown in drawing 16 (h) and (i), an insulator layer 50 is formed, using this resist pattern RP 3 again. As explained in the periphery of the GMR film 40, the bias film 85, and the 1st electrode layer 80, i.e., drawing 14, and drawing 15, an insulator layer 50 is formed so that the edge of the side which is distant from the surfacing side of the GMR film 40, the bias film 85, and the 1st electrode layer 80 may be covered. Therefore, since an insulator layer 50 is formed immediately after fabricating the GMR film 40 by ion milling, the edge of the GMR film 40 which ingredients, such as Cu, Co, etc. which are easy to be corroded with the solution in the process which forms a magneto-resistive effect mold head, expose can produce a magneto-resistive effect mold head, without not touching the solution in a process, therefore the GMR film 40 corroding.

[0126] After formation of an insulator layer 50, by removing excessive insulator layer 50A formed on the resist pattern RP 3 and

the resist pattern RP 3 using resist exfoliation liquid, as shown in drawing 16 (i), the 1st electrode layer 80 of a wrap is formed in the both sides of the GMR film 40 in the bias film 85, and the front face of those perimeters can consider as the configuration covered with the insulator layer 50.
[0127] Next, as shown in drawing 16 (j) and (k), the 2nd electrode layer 90 for connecting the GMR film 40 with a terminal is formed on the 1st electrode layer 80. Although the 2nd electrode layer 90 has flowed with the 1st electrode layer 80 in the end, the most is formed on an insulator layer 50. Therefore, an insulator layer 50 and the lower gap film 30 are formed in the bottom of it, and the greater part of 2nd electrode layer 90 can improve the withstand voltage between the lower shielding film 20.
[0128] Then, as explained in drawing 13 - drawing 15, sequential formation of the up gap film 60, the up insulator layer 55, and the up shielding film 70 is carried out. And it is cut along with B-B' shown in drawing 16 (k), the cutting plane is ground, and the magnetic head is formed. The cross-section structure of A-A' of drawing 16 (k) is as having been shown in drawing 13, the cross-section structure of D-D' of drawing 16 (k) is as having been shown in drawing 14, and the cross-section structure of E-E' of drawing 16 (k) is as having been shown in drawing 15.
[0129] Since he is trying to have an insulator layer 50 between the 2nd electrode layer 90 and the lower gap film 30 according to this operation gestalt as explained above while making the bias film 85 smaller than the 2nd electrode layer 90, the withstand voltage between the 2nd electrode layer 90 and the lower shielding film 20 can be improved.
[0130] Moreover, since he is trying to cover the edge of the side which is distant from the edge of the side which is distant from the surfacing side of the bias film 85, and the surfacing side of the 1st electrode layer 80 by the insulator layer 50, the withstand voltage between the bias film 85, the up shielding film 70, and the 1st electrode 80 and the up shielding film 70 can be improved.
[0131] Furthermore, since distance of the GMR film 40 by the side of a surfacing side and the up shielding film 70 is made smaller than the distance of the GMR film 40 in the location distant from the surfacing side side, and the up shielding film 70 by using an insulator layer 50, withstand voltage can be raised and dependability can be improved.
[0132] Moreover, it is the edge of the GMR film 40, and since he is trying to cover the edge of the side which is separated from a surfacing side side by the insulator layer 50, it is lost that cobalt (Co) and copper (Cu) in the GMR film 40 are corroded also in the case of removal of a resist.
[0133] In addition, it replaces with the GMR film, and although explained as magneto-resistive effect film as what uses the GMR film 40, even if it uses MR film, it can constitute from the above explanation similarly. When using MR film, on the lower gap film 30, the laminating of the alloy containing NiFe, a tantalum (Ta), a permalloy (NiFe alloy), and the tantalum (Ta) is carried out one by one, and MR film whose thickness is 50nm is formed of sputtering or CVD.
[0134] Since an insulator layer is formed in the edge distant from the surfacing side side of MR film also when using MR film, withstand voltage can be raised and dependability can be improved.
[0135] Next, the configuration of the magnetic storage using the magnetic head by each operation gestalt mentioned above is explained using drawing 17.
[0136] While the magnetic storage shown in drawing 17 is used for the magneto-resistive effect mold magnetic-head property check by each operation gestalt mentioned above, the property check as magnetic storage etc. is used.
[0137] The thin film magnetic-recording medium 210 of magnetic storage 200 can record the very high surface recording density which was [that there are few medium noises] excellent in the magnetic parametric performance of high coercive force. The thin film magnetic-recording medium 210 is driven in the record direction with a spindle motor 220.
[0138] The magneto-resistive effect mold head 230 is equipped with the Records Department and the playback section of the magneto-resistive effect mold shown in each operation gestalt mentioned above, and the guide arm 240 carries out relative motion to the magnetic-recording medium 210. The record regenerative-signal processing circuit 250 performs output signal playback from the signal input and the magneto-resistive effect mold head 210 to the magneto-resistive effect mold head 210.
[0139] The property of the magneto-resistive effect mold head 230 was checked using the magnetic storage 200 constituted as mentioned above. In addition, as magnetic storage 200, it has two or more magnetic-recording media 210, and is a nearby thing as a configuration with the magneto-resistive effect mold head 230 of plurality [arm / 240 / guide].
[0140] Moreover, the magneto-resistive effect mold head 230 which constitutes the magnetic storage by this invention is applicable not only to the spin bulb mold MR head using giant magneto-resistance (GMR) but the MR head using an anisotropy magneto-resistive effect (AMR).
[0141]
[Effect of the Invention] According to this invention, the withstand voltage between the magneto-resistive effect film and vertical shielding film in the thin film magnetic head is raised, and dependability can be improved.
[0142] Moreover, as magneto-resistive effect film of the thin film magnetic head, in case the GMR film is used, it can prevent that the GMR membrane end section receives a damage by resist exfoliation liquid or the penetrant remover.

[Translation done.]

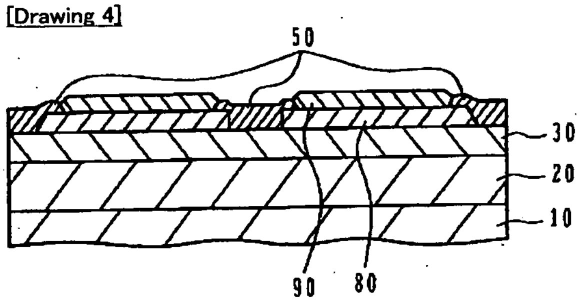
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the part plan of the thin film magnetic head by 1 operation gestalt of this invention.
[Drawing 2] It is drawing showing the cross-section structure of the thin film magnetic head by 1 operation gestalt of this invention, and is the A-A' sectional view of drawing 1 .
[Drawing 3] It is drawing showing the cross-section structure of the thin film magnetic head by 1 operation gestalt of this invention, and is the B-B' sectional view of drawing 1 .
[Drawing 4] It is drawing showing the cross-section structure of the thin film magnetic head by 1 operation gestalt of this invention, and is the C-C' sectional view of drawing 1 .
[Drawing 5] It is drawing showing the cross-section structure of the thin film magnetic head by 1 operation gestalt of this invention, and is the C-C' sectional view of drawing 1 .
[Drawing 6] It is process drawing showing the manufacture process of the thin film magnetic head by 1 operation gestalt of this invention.
[Drawing 7] It is drawing showing the cross-section structure of the thin film magnetic head by the 2nd operation gestalt of this invention.
[Drawing 8] It is drawing showing the cross-section structure of the thin film magnetic head by the 3rd operation gestalt of this invention.
[Drawing 9] It is the A-A' sectional view of drawing 8 .
[Drawing 10] It is the D-D' sectional view of drawing 8 .
[Drawing 11] It is the E-E' sectional view of drawing 8 .
[Drawing 12] It is process drawing showing the manufacture process of the thin film magnetic head by the 3rd operation gestalt of this invention.
[Drawing 13] It is drawing showing the cross-section structure in the 1st cutting plane of the thin film magnetic head by the 4th operation gestalt of this invention.
[Drawing 14] It is drawing showing the cross-section structure in the 2nd cutting plane of the thin film magnetic head by the 4th operation gestalt of this invention.
[Drawing 15] It is drawing showing the cross-section structure in the 3rd cutting plane of the thin film magnetic head by the 4th operation gestalt of this invention.
[Drawing 16] It is process drawing showing the manufacture process of the thin film magnetic head by the 4th operation gestalt of this invention.
[Drawing 17] It is the perspective view showing the configuration of the magnetic storage using the magnetic head by each operation gestalt of this invention.
[Description of Notations]
10 — Substrate
20 — Lower shielding film
30 — Lower gap film
40 — GMR film
50, 50A, 55 — Insulator layer
60 60A — Up gap film
70 — Up shielding film
80 90 — Electrode layer
85 — Bias film

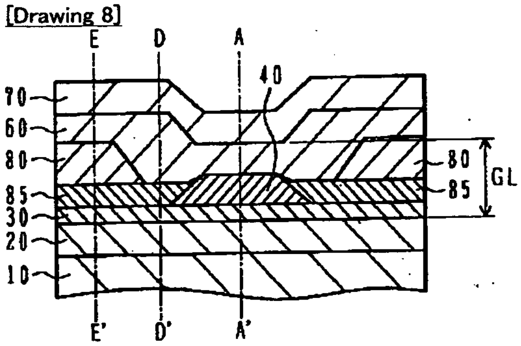
[Translation done.]

DRAWINGS

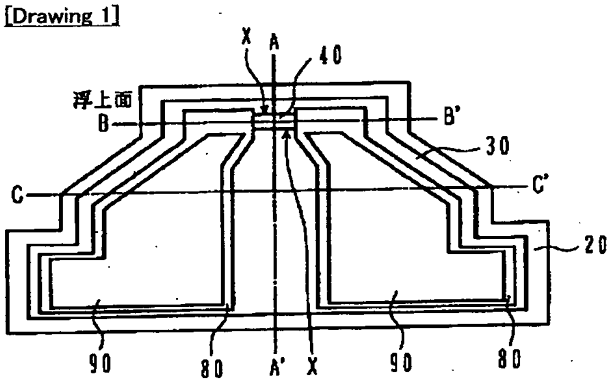
[Drawing 4]



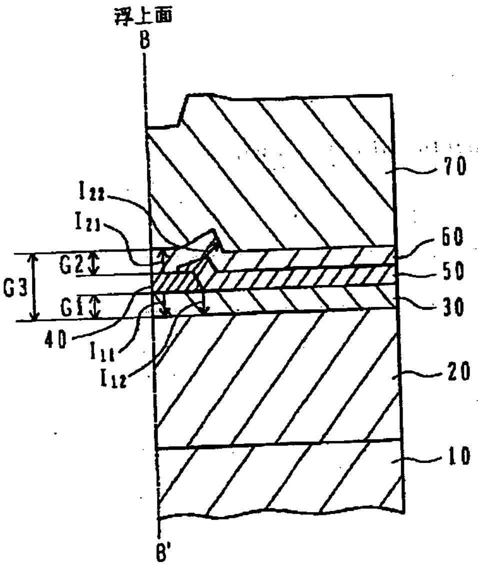
[Drawing 8]



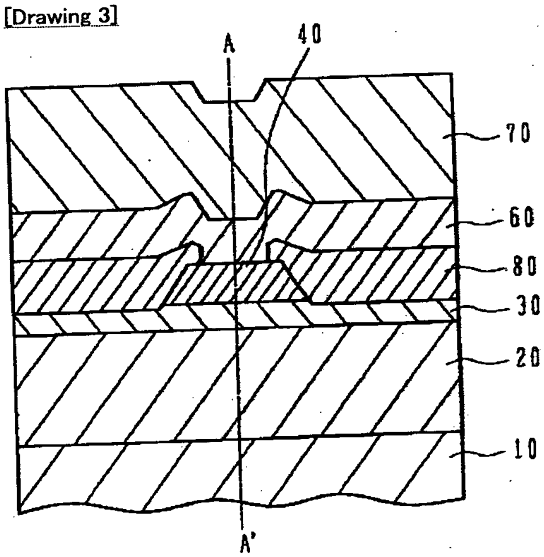
[Drawing 1]



[Drawing 2]



[Drawing 3]



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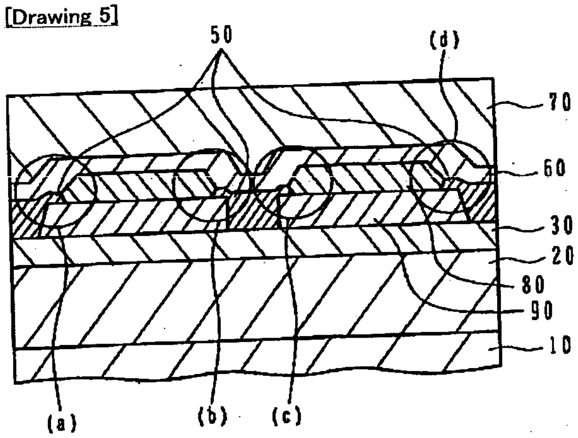
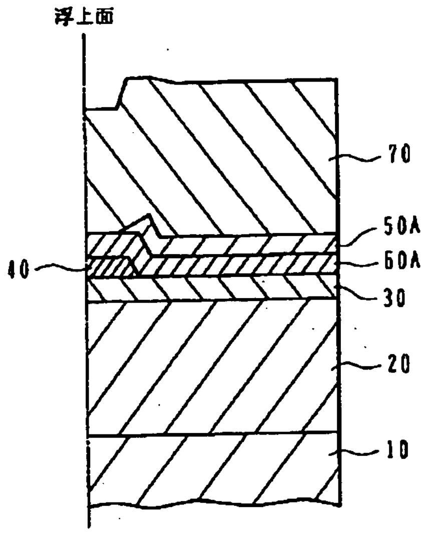
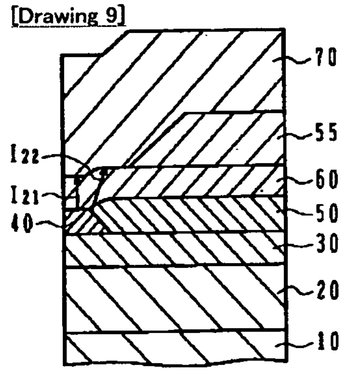


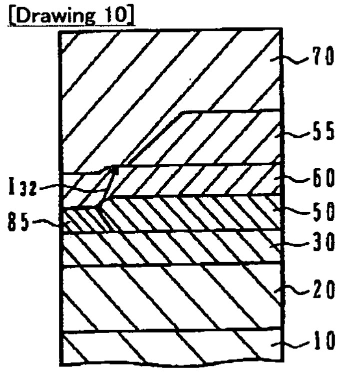
[Drawing 7]



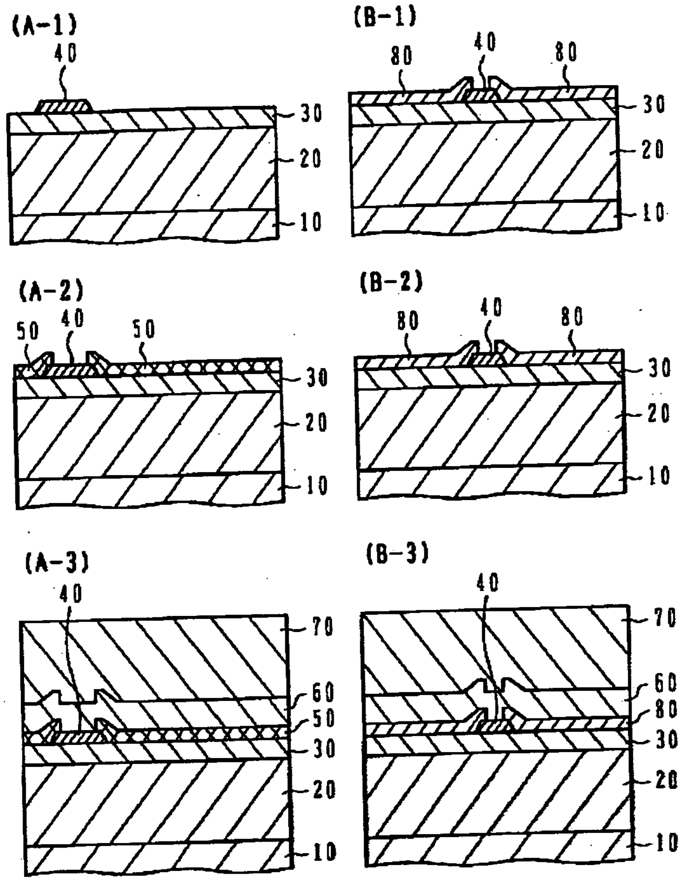
[Drawing 9]



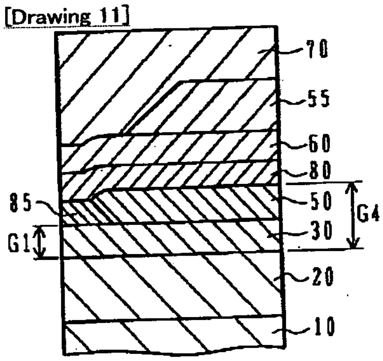
[Drawing 10]



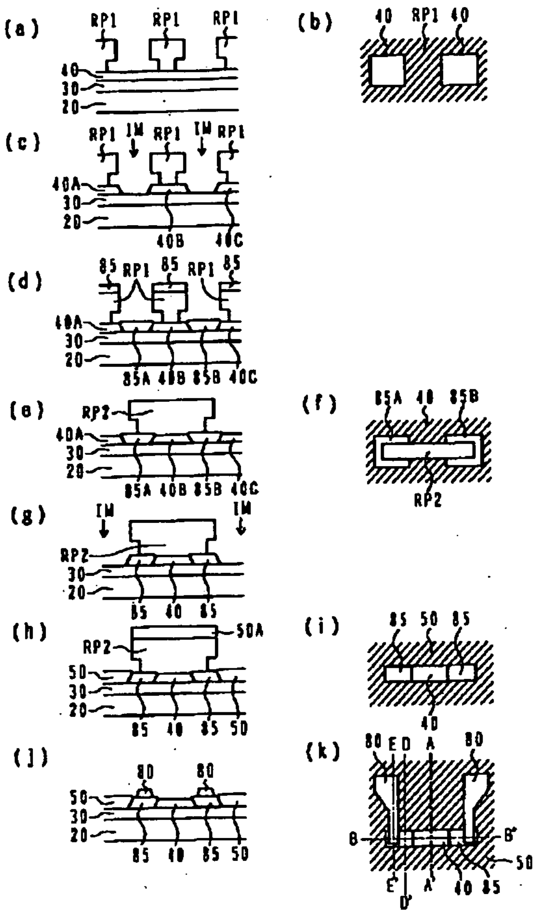
[Drawing 6]



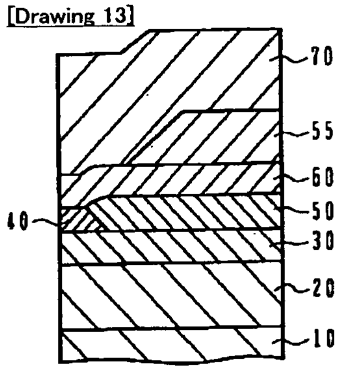
[Drawing 11]



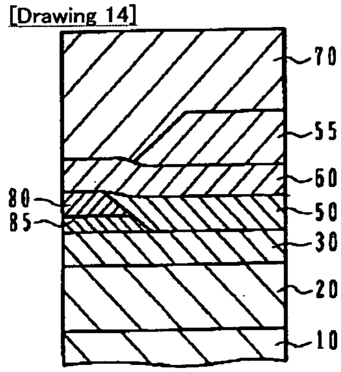
[Drawing 12]



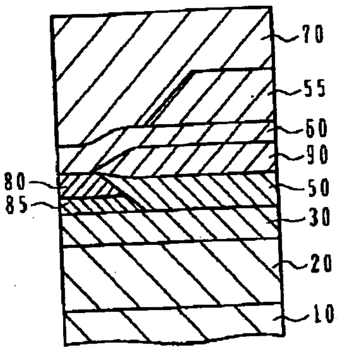
[Drawing 13]



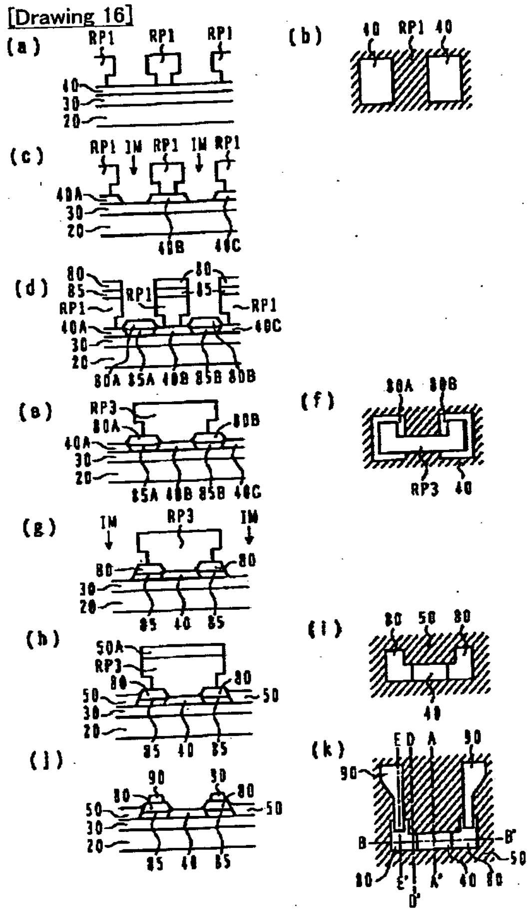
[Drawing 14]



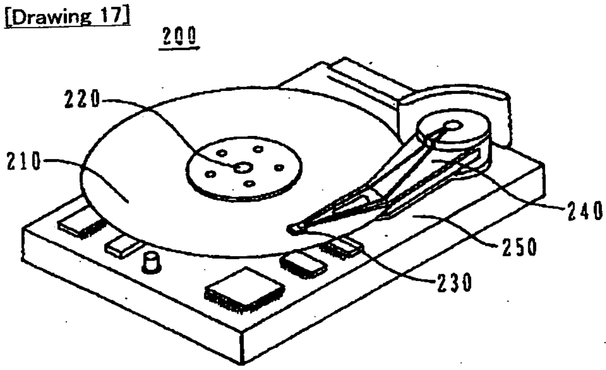
[Drawing 15]



[Drawing 16]



[Drawing 17]



[Translation done.]